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| **Contra Costa College** |

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| **Course Outline** |

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| **Department & Number** | MATH-200 | **Number of Weeks** | 18 |
| **Course Title** | Introduction to Linear Algebra  | **Lecture Hours By Term** | 72 |
| **Prerequisite** | MATH-191 ; may be taken concurrently. | **Lab Hours By Term** |  0 |
| **Challenge Policy**  | Satisfactory completion of an equivalent course. | **\*Hours By Arrangement** |  0 |
| **Co-requisite** |  | **Units**  |  4 |
| **Challenge Policy**  |  |  |  |
| **Advisory** |  |

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| **\*HOURS BY ARRANGEMENT:** | 0 | Hours per term.  |
|  **ACTIVITIES:** (Please provide a list of the activities students will perform in order to satisfy the HBA requirement): |
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| **COURSE/CATALOG DESCRIPTION** |

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| This course develops the techniques and theory needed to solve and classify systems of linear equations. Solution techniques include row operations, Gaussian elimination, and matrix algebra. Investigates the properties of vectors in two and three dimensions, leading to the notion of an abstract vector space. Vector space and matrix theory are presented including topics such as inner products, norms, orthogonality, eigenvalues, eigenspaces, and linear transformations. Selected applications of linear algebra are included. |

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| **COURSE OBJECTIVES:** |
| At the completion of the course the student will be able to: |

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| 1. Find solutions of systems of equations using various methods appropriate to lower division linear algebra;
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| 1. Use bases and orthonormal bases to solve problems in linear algebra.
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| 1. Find the dimension of spaces such as those associated with matrices and linear transformations;
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| 1. Find eigenvalues and eigenvectors and use them in applications; and
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| 1. Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.
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**INTENDED STUDENT LEARNING OUTCOMES:**

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| 1. Students will be able to convert linear systems of equations to matrix form and find their solutions.
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| 1. Students will demonstrate understanding of the algebra of matrices and the characteristics of specific matrices.
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| 1. Students will demonstrate understanding of the properties and construction of vector spaces and subspaces, and their application to matrices.
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| 1. Students will demonstrate understanding of eigenvalues, eigenvectors, eigenspaces, and their applications.
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 **COURSE CONTENT (Lecture):**

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| 1. Techniques for solving systems of linear equations including Gaussian and Gauss-Jordan elimination and inverse matrices;
2. Matrix algebra, invertibility, and the transpose;
3. Relationship between coefficient matrix invertibility and solutions to a system of linear equations and the inverse matrices;
4. Special matrices: diagonal, triangular, and symmetric;
5. Determinants and their properties;
6. Vector algebra for **R**n;
7. Real vector space and subspaces;
8. Linear independence and dependence;
9. Basis and dimension of a vector space;
10. Matrix-generated spaces: row space, column space, null space, rank, nullity;
11. Change of basis;
12. Linear transformations, kernel and range, and inverse linear transformations;
13. Matrices of general linear transformations;
14. Eigenvalues, eigenvectors, eigenspace;
15. Diagonalization including orthogonal diagonalization of symmetric matrices;
16. Inner products on a real vector space;
17. Dot product, norm of a vector, angle between vectors, orthogonality of two vectors in **R**n;
18. Angle and orthogonality in inner product spaces; and
19. Orthogonal and orthonormal bases: Gram-Schmidt process.
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 **COURSE CONTENT (Lab):**

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| **METHODS OF INSTRUCTION:** |
| Lecture and discussion |
| Demonstration and collaboration |
| Daily reading assignments |
| Homework exercises |

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| **INSTRUCTIONAL MATERIALS:** |

**NOTE:** To be UC/CSU transferable, the text must be dated within the last 7 years OR a statement of justification for a text beyond the last 7 years must be included.

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| Textbook Title: | Linear Algebra and Its Applications |
| Author: | David C. Lay |
| Publisher: | Addison Wesley |
| Edition/Date: | Fourth Edition / 2012 or most recent edition |
| Textbook Reading Level: |  |
| Justification Statement: | *(For textbook beyond 7 years)* |
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| Lab Manual Title  | (*if applicable*): |
| Author: |  |
| Publisher: |  |
| Edition/Date: |  |

**OUTSIDE OF CLASS WEEKLY ASSIGNMENTS:**

Title 5, section 55002.5 establishes that a range of 48 -54hours of lecture, study, or lab work is required for one unit of credit. For each hour of lecture, students should be required to spend an additional two hours of study outside of class to earn one unit of credit.

* State mandates that sample assignments must be included on the Course Outline of Record.

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|  **Outside of Class Weekly Assignments** | **Hours per week** |

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| Weekly Reading Assignments *(Include detailed assignment below, if applicable)* | 3 - 4 |

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| Students are responsible for reading the sections of the textbook corresponding to the week’s lectures. The number of sections covered per week may vary between 2 and 4. For the adopted text listed above, this translates to approximately 20 – 30 pages of reading per week. |

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| Weekly Writing Assignments *(Include detailed assignment below, if applicable)* |  |

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| Weekly Math Problems *(Include detailed assignment below, if applicable)* | 5 - 10 |

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| Students are assigned homework exercises by chapter, and are expected to complete the exercises as the material is covered in lecture. A typical assignment includes at least 5 – 8 problems per section of the text; this translates to a minimum of between 20 – 40 homework exercises per week. Note: 5 – 10 hours per week represents the minimum amount of time a student will spend on homework exercises |

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| Lab or Software Application Assignments *(Include detailed assignment below, if applicable)* |  |

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| Other Performance Assignments *(Include detailed assignment below, if applicable)* |  |

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**STUDENT EVALUATION**: **(Show percentage breakdown for evaluation instruments)**

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| * Course must require use of critical thinking, college-level concepts & college-level learning skills.
* For degree credit, course requires essay writing unless that requirement would be inappropriate to the course objectives. If writing is inappropriate, there must be a requirement of problem-solving or skills demonstration.
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|  | **%** | Essay (If essay is not included in assessment, explain below.) |
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| 25 | **%** | Computation or Non-computational Problem Solving Skills |
|  | **%** | Skills Demonstration |
| 75 | **%** | Objective Examinations |
|  |  | Other (describe) |
|  | **%** |  |
|  | **%** |  |
|  | **%** |  |

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|  **GRADING POLICY: (Choose LG, P/NP, or SC)** |
| **X**  | **Letter Grade** |  | **Pass / No Pass** |  | **Student Choice** |
| 90% - 100% = A  | 70% and above = Pass | 90% - 100% = A |
| 80% - 89% = B  | Below 70% = No Pass  | 80% - 89% = B |
| 70% - 79% = C  |  | 70% - 79% = C |
| 60% - 69% = D  |  | 60% - 69% = D |
| Below 60% = F  |  | Below 60% = F |
| *or* |
| 70% and above = Pass |
| Below 70% = No Pass |
| **Prepared by:** | Carol Stanton , Mathematics |

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| **Date:**  | Spring 2014 |

*Revised form 01/14*